Genetics and Evolution

The Material Basis of Evolution. By Richard Goldschmidt. Yale University Press. 436 pp. 1940. $5.00.

For over two thousand years men have been considering the idea of evolution as an explanation of the origin of living things as they exist today. John M. Coulter (Science, 1926) divided the history of evolution into three periods: Speculative, to 1790; Observation and Inference, 1790-1900; and Experimental, 1900 to date. Each of these periods may be said to have made certain definite contributions to the progress of the whole concept. Through speculation men came to realize that there are only three or four conceivable explanations for existence of present-day living things, *viz.,* special creation, spontaneous generation, evolution, with the "cosmozoa" concept as a possible fourth. As more and more data were accumulated in the field of biology and in other sciences, it became obvious that only one of the four was susceptible of factual substantiation, and the speculative period ended when the purposeful assembling of supporting evidence for evolution began.

This second or inductive period reached its climax with the appearance of Darwin's "Origin of Species," when the overwhelming weight of all the facts obtained from the study of the distribution of living things in time and in space, from comparative anatomy, embryology, and the rest, combined to carry conviction as to the historicity of the evolutionary process. In the forty years which followed 1859, little more was accomplished in a fundamental way except through the addition of many more positive data, and the recognition that there was little if any evidence for which a negative interpretation could be given. It did become clear, however, that little was really settled as to the method of evolution. Attention was therefore focussed on the necessity for the experimental study of variation and inheritance as to the focal processes in any evolutionary change.

With Mendel's rediscovered experiments as a basis, the concentrated attack of many investigators, using many different organisms, especially in the fields of experimental breeding and cytology, have combined to unravel many problems. The reasons why offspring resemble or differ from their parents seem to have been pretty well elucidated. So complete has the solution of the problem of variation seemed to many of those who have grown up in their biology during the development of genetics that this closely focussed picture of the details of variation has come to be regarded as furnishing an adequate explanation of the whole process of evolution.

However, for at least half this forty-year period of experimental study there have been those who have questioned, not the value or validity of genetics within its field, but its sufficiency as an explanation of the "origin of species," and even more, of its adequacy to account for the appearance and differentiation of the higher categories of classification. The significance of "gene mutations," the key processes from the geneticist's point of view, is discounted; the great majority of those reported are minute in degree and have no survival value, even for minor varieties, let alone for groups of specific rank.

In this period of challenge and examination of the bearing of "gene mutations" on evolution, Richard Goldschmidt has been a leading figure. A systematist who has studied the gypsy moth in its wide north temperate distribution, and a geneticist who has made contributions of recognized importance to our knowledge of the inheritance and expression of sex, he is convinced that "gene mutations" have no bearing on evolutionary changes beyond the grade of races, geographical varieties, and other categories below the grade of species. Such minor differentiation he classes as "microevolutionary" variation.

For the production of a new species, a "macroevolutionary" variation in the germ plasm is needed. He finds the genetic basis for such changes in the complete reorganization of chromosomes which he believes is accomplished by translocations, segmental interchanges, by which he believes not particulate variations are brought about but a whole nexus of changes. The resulting organisms would stand apart as completely differentiated new species. In his view, a chromosome is not to be regarded as a grouping of discrete genes, like separate beads on a string, but rather as a unified chemical entity in the nature of a long chain molecule. The complex of characteristics of a species arises from the pattern of the chromosomes taken as wholes. Change a few small loci in a chromosome and you have still the old pattern with minor variation ("gene mutations"), but reorganize and redistribute the chromosome parts and you have new "genetic molecules" and the pattern for a different species.

As to the validity of Goldschmidt's concepts, this reviewer does not attempt to pass judgment. It would appear that we are in a period of appraisal and evaluation of the significance of the many important contributions of modern genetics on the broader field of evolution. That many geneticists have been too ready to assume the complete sufficiency of genetics seems obvious. That a final solution will require a synthesis of many fields of evidence, paleontology, taxonomy, anatomy and embryology, as well as cytology and genetics, seem equally self-evident. Goldschmidt brings to bear a very extensive experience in more than one field; his discussion is stimulating and constructive.

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FIELD TRIPS OF THE CLUB

Trip of June 29, 1941, to Quarry Lake

Nineteen members and guests were present on this trip, made possible again[1] through the kindness and courtesy of Mr. and Mrs. Nathan Straus, to whom, as well as to Mr. and Mrs. Ernest Hoelle, the Club is deeply indebted. Mr. Hoelle acted as co-leader and provided transportation. Mrs. Hoelle generously provided cooling drinks and refreshments during the heat of the day in a picnic setting.

Considerable time was devoted to touring the formal gardens, lawns, and borders, with their wealth of cultivated plant material brought in from all portions of the globe. Among the most interesting of the plants studied were *Salpiglossis sinuata, Syringa villosa, Campanula celtidifolia, Hypericum patulum* var. *henryi, Paeonia suffruticosa,* two species of *Browallia, Sedum acre, Negundo aceroides, Cobaea scandens, Heliopsis scabra* var. *zinniaeflora, Lunaria annua, Daphne mezereum, Centaurea americana,* and numerous species and varieties of *Chaenomeles, Lilium, Limonium,* and *Philadelphus.*

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[1] For report of our previous trip to Quarry Lake see Torreya 39:178–180.